Lake Michigan – A "Working Lake"

While beautiful to look at and fun to swim in, Lake Michigan is also a "working lake." We use its water for manufacturing, for cooling as part of energy production, for shipping, and for recreation. It's a critical part of Wisconsin's economy. The lake serves as a wet highway extending to Europe and the Far East, with major shipping ports in Green Bay, Milwaukee and Duluth-Superior. Whether it is paper produced in the Fox Valley or mining shovels made in Milwaukee, the availability of water and a cheap, easy way to transport goods brought many industries to Wisconsin. Lake Michigan cities also benefit from charter fishing, recreational boating and marina activity. All these uses have placed stress on the lake. We need to use Lake Michigan, but we need to do so in a way that prevents pollution and restores and protects water quality and habitat.

Lake Michigan's "Areas of Concern"

"Areas of Concern" are places that need special attention because of their history of industrial pollution. These areas are often contaminated with chemicals such as polychlorinated biphenyls (PCBs) and heavy metals or an excess of nutrients. Nutrients (fertilizer, animal waste) and other pollutants from cities and farmlands are carried into the lake by rain and melting snow. This type of runoff is called non-point source pollution. Of the 43 "Areas of Concern" in the Great Lakes, ten are on Lake Michigan and four of these are in Wisconsin. They include the Menominee River, the Fox River/Lower Green Bay, the Sheboygan River, and the Milwaukee River Estuary. All of these areas have projects underway to address the pollution – but cleanup is expensive and time consuming, reminding us that prevention is critical.

Giving the Lake a Helping Hand – Lake Michigan Restoration

There are a number of projects underway to help improve water quality, habitat, and the food web of Lake Michigan. Just a few of the many successful projects include:

- Fish rearing stations that use water from the Milwaukee and Manitowoc Rivers to raise sturgeon to help the Lake Michigan sturgeon population recover. Through this process the sturgeon are able to recognize these river waters and therefore have a better chance to return to these rivers to spawn than if they were raised in hatcheries. When the fish are released they become part of the Lake Michigan sturgeon population.
- Contaminated sediment being removed in the Fox and Sheboygan River, including the removal of more than 650,000 cubic yards (the equivalent of more than 40,000 dump truck loads) of PCB-contaminated sediment since 2000. This is improving water quality and lowering contaminant levels in fish.


Coho salmon

- Removal of the Milwaukee River's North Avenue Dam has opened up 30 miles of river to salmon spawning from Lake Michigan. In addition, 32 acres of stream bank and wetlands were restored adding wildlife habitat. Two years after the dam removal and habitat improvement the number of fish species in the river grew from six fish species to 30 species.

Threats to Lake Michigan


Sea lamprey

Invasive species, polluted runoff from city stormwater and farm fields, and changes to stream bank habitat are just some of the threats to Lake Michigan. The "big pond" is now home to over 186 invasive aquatic species, including zebra mussels, quagga mussels, round gobies, sea lamprey, and phragmites. These invaders steal habitat and food from native plants and animals. Human use of Lake Michigan can also harm water quality and aquatic ecosystems. Closed beaches from bacteria contamination, piles of stinky nuisance algae on the beach, less habitat for native birds, fish, animals and plants, and disrupted food webs are the result of these changes to the ecosystem. We need to work together to address and prevent these hazards.

Fluctuating Lake Levels

Lake levels are determined by precipitation and air temperatures. Higher air temperatures increase evaporation, and winter ice cover reduces evaporation, so hotter weather and less winter ice lowers water levels. For almost a decade, Lake Michigan water levels have been below the long term average, with early 2008 levels measuring about two feet below the long term average. Low lake levels impact shipping, recreational boating, beaches, fishing, and aquatic habitat. A new study that Wisconsin DNR is actively participating in is under way to understand the relationship between water flows out of Lake Superior and the impact on Lake Michigan water levels.


Great blue heron

Learn more about the Great Lakes, the Lake Michigan watershed and the species that call it home by visiting,

- EEK! Wisconsin DNR's Environmental Education web site for kids – **http://dnr.wi.gov/eek/**
- Wisconsin DNR's Office of the Great Lakes – **http://dnr.wi.gov/org/water/greatlakes/**

What can YOU do?

- ☑ Keep rainfall on your property, install rain barrels and rain gardens (http://dnr.wi.gov/runoff/rg/)
- ☑ Conserve water around your house and property (http://dnr.wi.gov/org/water/dwg/gw/pubs/bhgw.pdf)
- ☑ Limit use of fertilizer
- ☑ Plant buffers (native plants are best) along shorelines and river banks (http://dnr.wi.gov/org/water/wm/education/prevent.html)
- ☑ Maintain your septic system if you have one (http://www.uwex.edu/ces/cty/monroe/cnred/documents/B3583-SepticSystemMaintenance.pdf)
- ☑ Properly dispose of household chemicals and prescription drugs at Clean Sweep Programs, don't flush them down the toilet or sink drain (http://dnr.wi.gov/org/aw/wm/pharm/pharm.htm)
- ☑ Inspect boat/trailer for invasive species, remove and dispose of aquatic plants and animals, drain water and don't move live fish or water from one water body to the next (http://dnr.wi.gov/invasives/action_water.htm)
- ☑ Reduce your energy use and contribution to climate change (http://www.epa.gov/climatechange/kids/difference.html)
- ☑ Participate in a local watershed organization or stakeholders group that focuses on Lake Michigan restoration (http://basineducation.uwex.edu/)

For Teachers

Sum of the Parts

Grade Level: Upper Elementary, Middle School

Subject Areas: Environmental Science, Government

Duration: Preparation time: 50 minutes

Activity time: 50 minutes

Setting: Classroom

Skills: Gathering information (observing); Organizing (arranging); Analyzing (identifying components); Interpreting (identifying cause and effect); Applying (proposing solutions)

Charting the Course Supplement this activity with activities on runoff ("Just Passing Through," "A-maze-ing Water," and "Rainy-Day Hike") and water use practices ("Common Water"). Aspects of water quality monitoring are introduced in "Macroinvertebrate Mayhem."

Vocabulary point source pollution, nonpoint source pollution, Best Management Practices

You have just inherited valuable riverfront property with a new house and a resort on it. On the day you move in, you discover the beach polluted with oil and littered with construction materials and animal waste! Where did all this stuff come from?

Summary

Students demonstrate how everyone contributes to the pollution of a river as it flows through a watershed and recognize that everyone's "contribution" can be reduced.

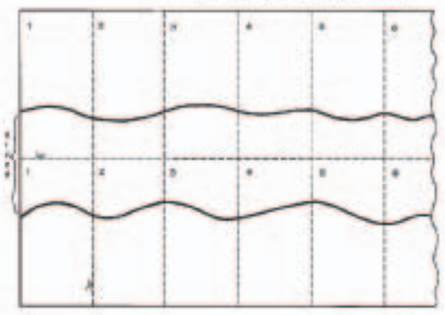
Objectives

Students will:

- distinguish between point and nonpoint source pollution.
- recognize that everyone contributes to and is responsible for a river or lake's water quality.
- identify Best Management Practices to reduce pollution.

Materials

- *Large piece of poster board or newsprint* (Using blue marker, draw and color a river on poster board, as shown below. Divide the stream in half down the middle and crosswise into sections. Each section should include a bit of river and blank space to allow room for students' drawings. The number of sections should correspond with the number of students or groups of students working together. Number the sections on one side of the river in sequential order, placing numbers in upper left-hand corners and repeat for the other side. Cut out the sections of stream. For durability, sections can be laminated.)



- *Drawing pens and pencils*
- *Items from students' desks (e.g., pencil, paper clip, book)*

Making Connections

In math class, students add a list of figures to obtain the total or "sum" (of the parts). Most students have attended a large gathering (concert, sporting event) and have been amazed at the amount of garbage left behind. Each person in attendance probably did not leave much on the ground, but with 500, 1,000, or more people doing the same, the total amount was large. Taking a closer look at how students can positively or negatively contribute to water quality helps them appreciate their role in water quality management.

Background

The quality of water in a river (or lake) is, to a large extent, a reflection of land uses and natural factors found in its watershed. If soil near a river or lake naturally erodes, chances are the river has sediment and turbidity problems.

If the land has stable vegetative cover, erosion is kept in check. When humans settle and develop land, water quality is affected. Breaking sod, cutting forests, building cities, mining, and other land uses make an impact upon water quality.

Everyone bears responsibility for the health of a watershed and the water systems (rivers, lakes, wetlands, etc.) within a drainage basin. Individual actions, both negative and positive, add up. Understanding a river or lake's water quality and quantity involves investigating the condition of the contributing watershed. If the watershed is polluted, the river will likely be polluted.

Watershed investigations are conducted for many reasons. Some investigations monitor changes in river and stream flows over time, to protect fisheries, to regulate floods, or to meet seasonal demands. Other studies determine the best method of protecting a river or lake from pollutants. One aim of a researcher might be to determine which areas of a watershed contribute the highest percentage of contaminants. This information is vital to policymakers and water managers when determining how best to spend money for improvements. For example, most lake improvement projects address problems in the watershed as well as those of the lake. It would prove fruitless to spend thousands (or even millions) of dollars to clean up a lake, if problems in the watershed will only pollute the lake again.

When watershed managers investigate land use practices that might affect the quality of water, they are concerned with two general sources of pollutants: point and nonpoint.

Point source pollution involves pollutants that are discharged from, and can be traced back to, an identifiable point or source, such as a factory's

Major Sources of NPS Pollution and BMPs

Source	Best Management Practices:
Roads and Streets	• dispose of paints, solvents, and petroleum products at approved disposal sites, not in storm drains or street gutters • fix automobile oil and fuel leaks • stop oil dumping on rural roads • use nonchemical deicers (sand and ash) on roads, sidewalks, and driveways • construct a sediment catch basin to collect storm water runoff • reduce road construction runoff by building terraces and catch basins, and by planting cover crops
Agriculture	• read and follow all labels and ask for application directions before using chemicals, fertilizers, and pesticides • use conservation tillage • use contour farming • use strip cropping • leave filter strips and field borders along wetlands and streams • use a cover crop to protect exposed soil • rotate crops • plant shelter belts and windbreaks • institute pasture management • terrace areas prone to erosion • construct livestock waste collection and treatment ponds for confined livestock • use grassed waterways • seal abandoned or waste disposal wells • fence waterways to reduce riparian zone impact by livestock
Logging	• monitor water entering and leaving cut areas • prevent sediments from reaching streams and lakes by building terraces, catch basins, and natural filters • leave a vegetative buffer zone in riparian areas • maintain and restore effective watersheds • implement a plan to reduce erosion from roads
Mining	• monitor all water entering and leaving mine sites • intercept and reroute uncontaminated water away from contaminated areas (keep clean water clean!) • construct catch basins and terraces, and plant cover crops, to catch sediment and prevent erosion • catch and treat contaminated water (clean contaminated water!) • stabilize stream channels • stabilize mining waste areas to prevent release of materials to streams • maintain buffer strips along streams
Construction	• implement a sediment control plan • plant ground cover to reduce erosion • dispose of solvent, paint, and other wastes at approved disposal sites • build temporary, small dikes to slow and catch runoff • build sediment catch basins to collect construction runoff • build earth berms and filter runoff before water enters stream
Residential	• use nonchemical deicers (sand and ash) on residential driveways and sidewalks • read labels prior to using pesticides and fertilizers • consider xeriscaping • use nonchemical fertilizers (compost) on gardens • dispose of household hazardous waste at approved disposal sites • maintain septic tanks if sewers are not available

discharge pipe or a sewage ditch. Nonpoint source (NPS) pollution occurs when the source of a contaminant is unidentifiable; that is, the pollutant can come from one of many places. Examples of nonpoint source pollution include runoff from agricultural fields containing fertilizers and pesticides, motor oil filtering from urban areas, and sediments from eroded stream banks.

Surface runoff and ground water can transport both point and nonpoint source pollutants. Since point source pollutants are identifiable, they are easier to monitor.

The protection of surface and ground water resources from NPS pollution presents an enormous challenge because of the widespread and diverse nature of the problem. Land and water managers rely on methods called *Best Management Practices*, or BMPs, to describe land use measures designed to reduce or eliminate NPS pollution problems. A list of nonpoint source pollution sources and suggested BMPs can be found in the side bar on the previous page.

Procedure

Warm Up

Determine student knowledge about watersheds by asking them to name several major North American rivers (e.g., Mississippi, Columbia, Missouri, Hudson, and Rio Grande).

Where do these rivers originate (where are the headwaters) and end? How many states does each cross or touch?

Discuss some of the predominant types of land uses found along one river as it flows through a single state. Do students think these practices could affect the river? What do students think the attitude of downstream state residents might be about the water received from their upstream neighbors?

The Activity

1. **Inform students that they have just inherited a piece of riverfront property and a million dollars. Have them list ways they could use the land and the money.**

2. **Pass out "pieces" of property and drawing pens and pencils. Explain that the blue is water and the blank space is land they own. They have one million dollars to develop their land as they wish.** They can farm or ranch; build resorts, homes, factories, or parks; plant forests, log, mine—whatever they like.

3. **When students have completed their drawings, ask them to look in the upper left-hand corner of their property for a number. Explain that each piece is actually a part of a puzzle. Starting with number one, have students assemble their pieces.** They will construct the stream pathway and adjacent land area in proper order. (The ones should face each other, with the twos next to them, and so forth.)

4. **Have students describe how they developed their land and how they used water. They should identify any of their actions that polluted or added materials to the waterway. Have students represent each of their contributions to the river with an item from their desks (e.g., book, piece of paper, pen, pencil).**

5. **Tell students to take their item(s) and line up in the same order as their pieces of river front property. They are going to pass their pollution pieces downstream. Have them announce what kind of pollutant they are holding before they pass it on.** The ones will pass their item(s) to the twos, the twos will pass everything to the threes, and so on, until the last students are holding all the items.

Wrap Up and Action

After all the items have reached the final students, discuss the activity. How did those students toward the middle or at the end of the river feel? What about their property use plans? Could a student downstream be affected by the actions of a student upstream? Could upstream


Simulated point and nonpoint source pollution collected during "Sum of the Parts."

users alter the water quality of those downstream?

Tell students to reclaim their items. Explain that the items easily identifiable as their own simulate point source pollution. Other items (e.g., pencils, paper clips, notebook paper) may be more difficult to claim, because these kinds of pollutants originated from multiple sources. Tell students these represent nonpoint source pollution.

As a follow-up, have each student write one paragraph detailing ways to reduce the amount of pollution he or she contributed. (Share the *Major Sources of NPS Pollution* and BMPs from **Background**.) Students can research the regulations governing waterfront property in their communities. If they believe their waterways are poorly treated, they may want to write letters to local government officials supporting environmentally sound land use legislation.

Assessment

Have students:

- express their opinions about individual contributions to total water quality (***Wrap Up***).
- write a paragraph identifying what they can do to protect water quality (***Wrap Up***).
- discriminate between point and nonpoint source pollutants (***Wrap Up***).

Upon completing the activity, for further assessment have students:

- design a community that uses Best Management Practices that allow for minimum contribution of pollutants.

Extensions

Instead of a river, have students represent a lake system. One student represents a lake. A group of students encircle the student representing the lake; they are houses around the lake. Other students, standing in lines extending from the lake, can be streams flowing to the lake. Students pass their item(s) downstream and into the lake until all the items are held by the person in the middle who represents the lake.

Have students adapt the activity to represent a river system that includes tributaries flowing into a main channel.

Complete the main activity using real water users within the watershed where students live. Or assign roles (farmers, suburban dwellers, etc.) to students and have them develop their land accordingly. How would they manage their land to protect water resources?

Resources

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Lake Michigan FACTS

One-quarter of Wisconsin's land area lies within the Lake Michigan watershed.

About 40 percent of Wisconsin's population lives in the Lake Michigan watershed.

Lake Michigan is one of the five Great Lakes, which include Lake Superior, Lake Huron, Lake Erie and Lake Ontario.

Lake Michigan has a surface area of 22,300 square miles and a volume of 1,180 cubic miles. It has the third largest surface area after Lake Superior and Lake Huron, and the second largest volume after Lake Superior.

Lake Michigan is the largest freshwater lake wholly within the U.S. and the 5th largest lake in the world.

Lake Michigan has 1,638 miles of shoreline including all the islands – a distance comparable to driving from Green Bay to Miami, Florida.

Lake Michigan is home to the nation's third-largest population center – Chicago.

Lake Michigan provides drinking water for over 10 million people.

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Special thanks to the **Natural Resources Foundation's C.D. Besadny Conservation Grant Program** for partially funding the printing of this publication.

PUB CE-470 2008

Printed on Recycled Paper